

High Precision Construction and Reduced Overnight Cost and Schedule

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Recent Experience in Nuclear Construction

VC Summers, SC, USA



(2008): Two 1,100 MW AP1000 pressurized water reactors originally projected to cost **\$9.8B**.

(2017): Westinghouse files for bankruptcy. Latest estimate: **\$23B**

Plant Vogtle, GA, USA



(2005): Unit 3&4 originally projected to cost **\$14 billion**.

(2023): Latest estimate: **\$30B**

Flamanville, France



(2007): Unit 3 originally projected to cost **€3.3B**.

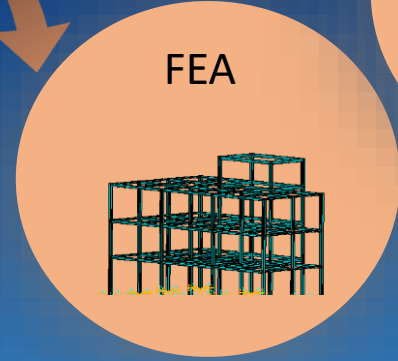
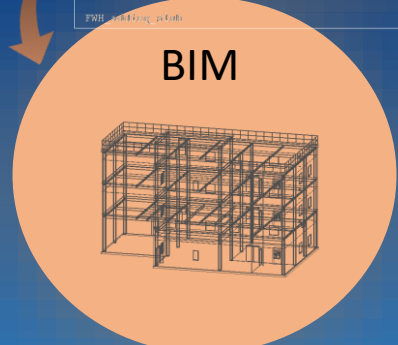
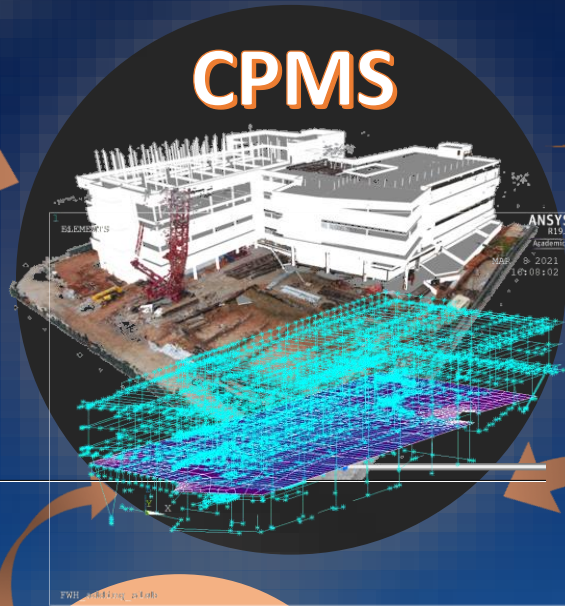
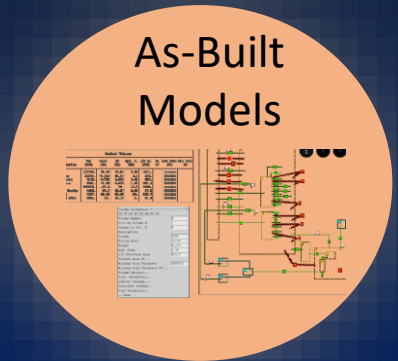
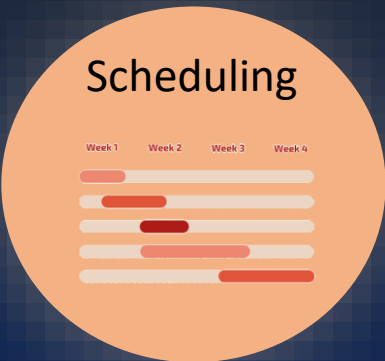
(2023): Latest cost estimate: **€13B**

Recent Experience in Nuclear Construction

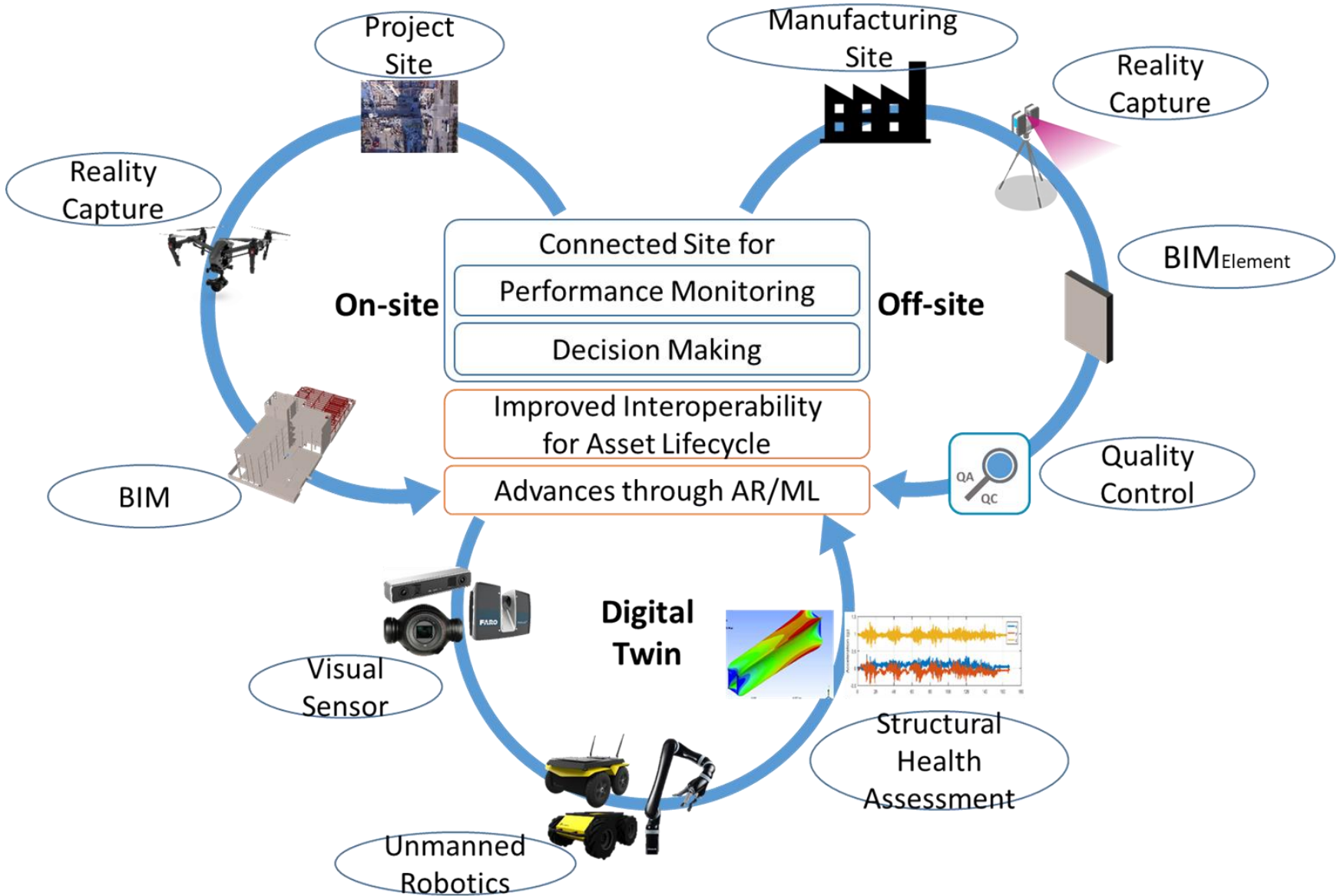
- Construction plans and schedules not reflective of on-site reality;
- Project management integration is poor. Approvals of changes through paperwork between construction supervisors, inspectors, decision makers, regulators, and owners.
- Lack of communication and information flow at all levels. Very slow pace and lack of understanding of the real issue at all stages.
- Mismatch in as-design and as-built & compatibility of modular components;
- Lack of real-time info for oversight;
- Incomplete & missing inspection records

Construction Performance Modeling and Simulation (CPMS)

- Project Management
- Design Changes
- Construction
- Inspection Requirements
- Accelerated Licensure



Holistic Approach to Performance Management at Project Site and Off-Site Facilities



Virtual Platform for Performance Monitoring & Simulation

The screenshot displays the POWER AI web application interface. On the left is a project tree with a hierarchical structure:

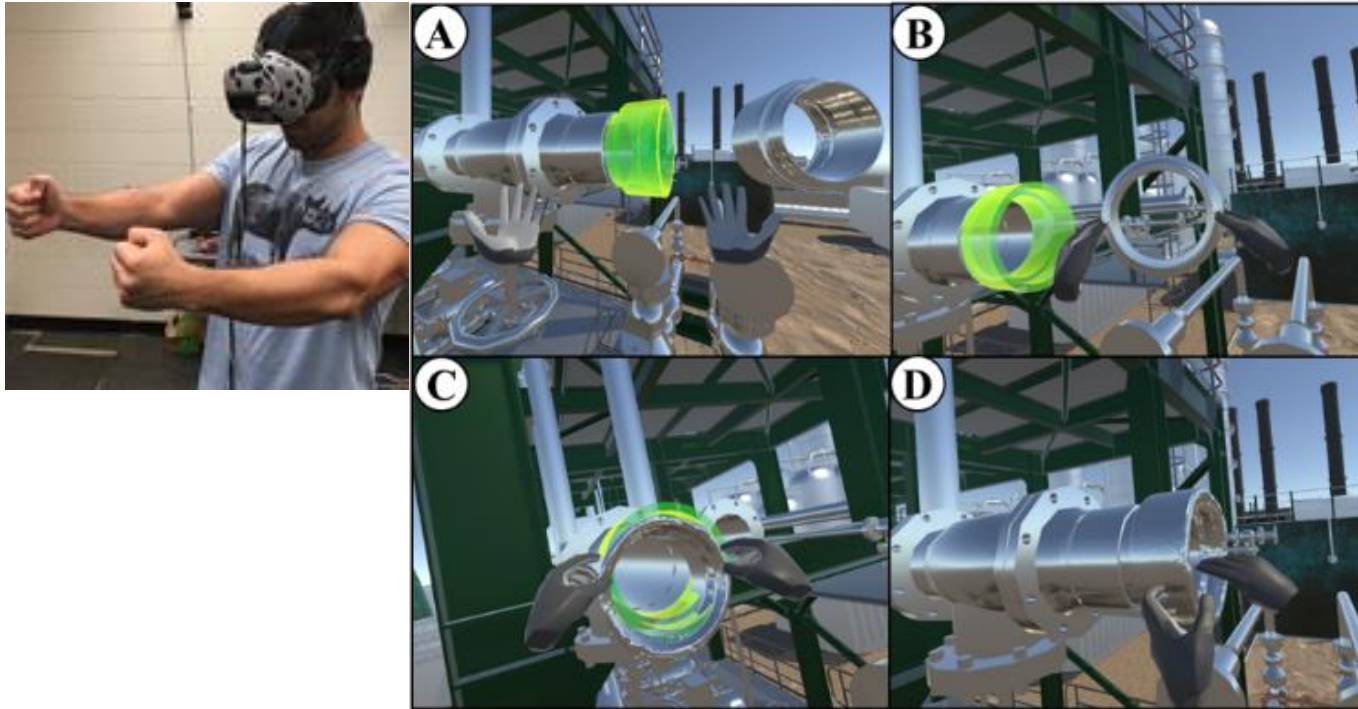
- PROJECT
 - SITE:Default
 - BUILDING:
 - BUILDINGSTOREY.FOOTINGS BOC
 - BUILDINGSTOREY.PIER TOC
 - BUILDINGSTOREY.LEVEL 1 TOC
 - SLAB
 - WALL
 - BEAM
 - REINFORCINGBAR
 - MEMBER
 - COLUMN
 - BUILDINGELEMENTPROXY
 - BUILDINGSTOREY.LEVEL 2 TOS
 - BUILDINGSTOREY.LEVEL 2
 - BUILDINGSTOREY.CRANE SUPPORT TOS
 - BUILDINGSTOREY.LEVEL 3 TOS
 - BUILDINGSTOREY.LEVEL 3
 - BUILDINGSTOREY.LEVEL 4 TOS
 - BUILDINGSTOREY.PENTHOUSE
 - BUILDINGSTOREY.TOS PARAPET
 - BUILDINGSTOREY.ROOF TOS
 - BUILDINGSTOREY.ROOF

The main view shows a 3D aerial simulation of a construction site with various building footprints and structures. A toolbar at the top right includes options for BIM, Point Cloud, Image, and Ghost. Below the simulation is a Gantt chart interface with tabs for Gantt Chart, Requirements, and Manager. The Gantt chart is titled "Schedule - 1/17/2021, 7:00:00 PM" and shows a timeline from January to April 2021. A table below the Gantt chart lists tasks with their start and finish dates:

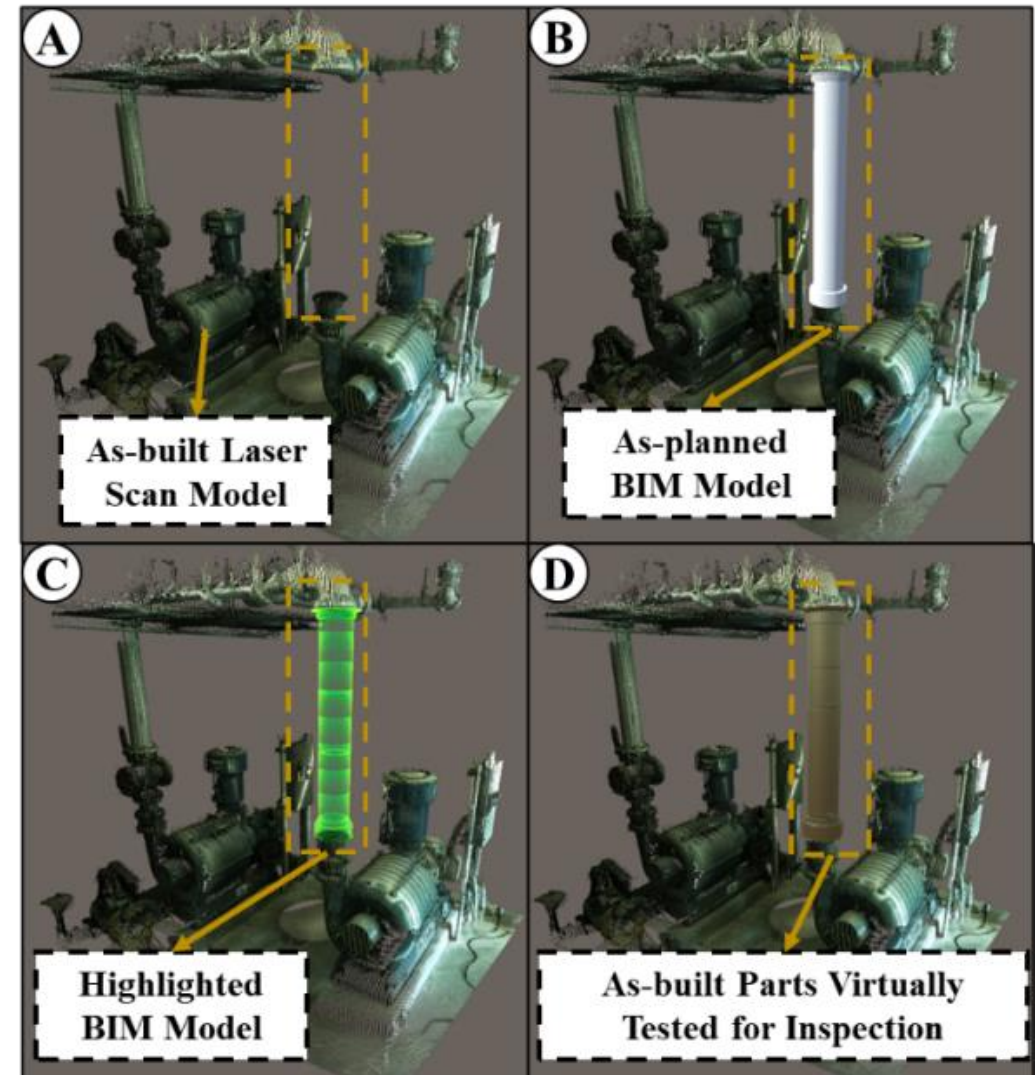
WBS	Task	Start	Finish
5	Main shafts floor 1	Sun, 24 January 2021	Sun, 7 February 2021
6	main shafts floor 2	Tue, 9 February 2021	Fri, 19 February 2021
7	thick foundation slabs	Sat, 23 January 2021	Thu, 18 February 2021
8	foundation slabs	Mon, 1 March 2021	Sun, 14 March 2021
9	truck bay columns	Thu, 11 March 2021	Mon, 12 April 2021
10	main shafts floor 3	Wed, 10 March 2021	Sun, 11 April 2021

VR for Virtually Managing QA/QC in Supply Chain

Manual Virtual Inspection



Automatic Virtual Inspection

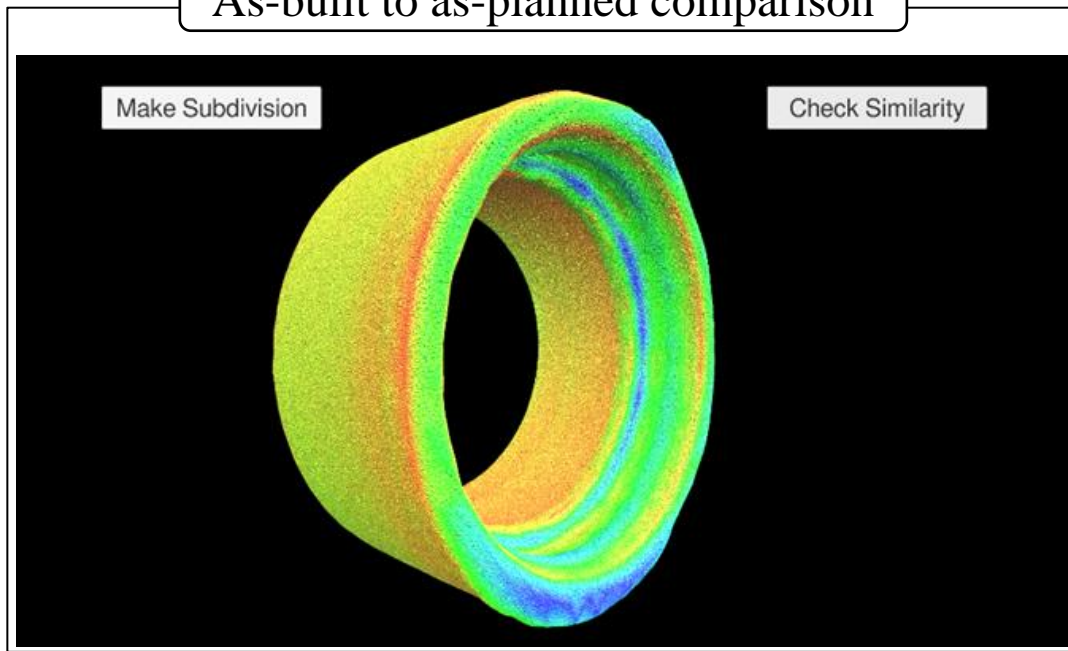


- ▶ Retrofitting SMR to existing refinery/coal plant
- ▶ Replacement of old generator

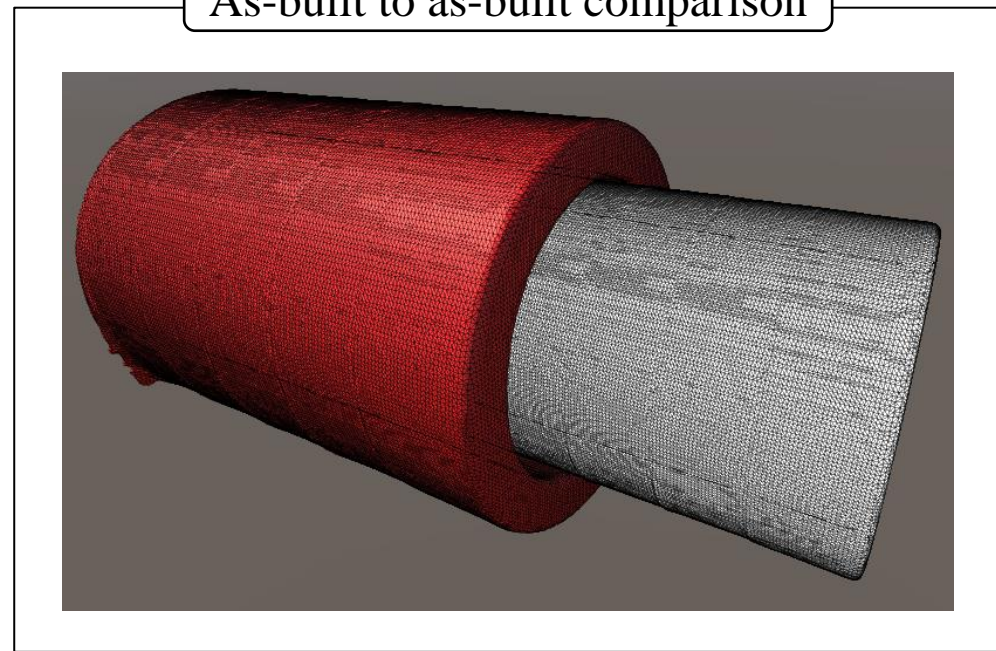
Compatibility Check (also for Microreactor)

- ▶ Comparison between design and as-built models
- ▶ Compatibility check between two modular components

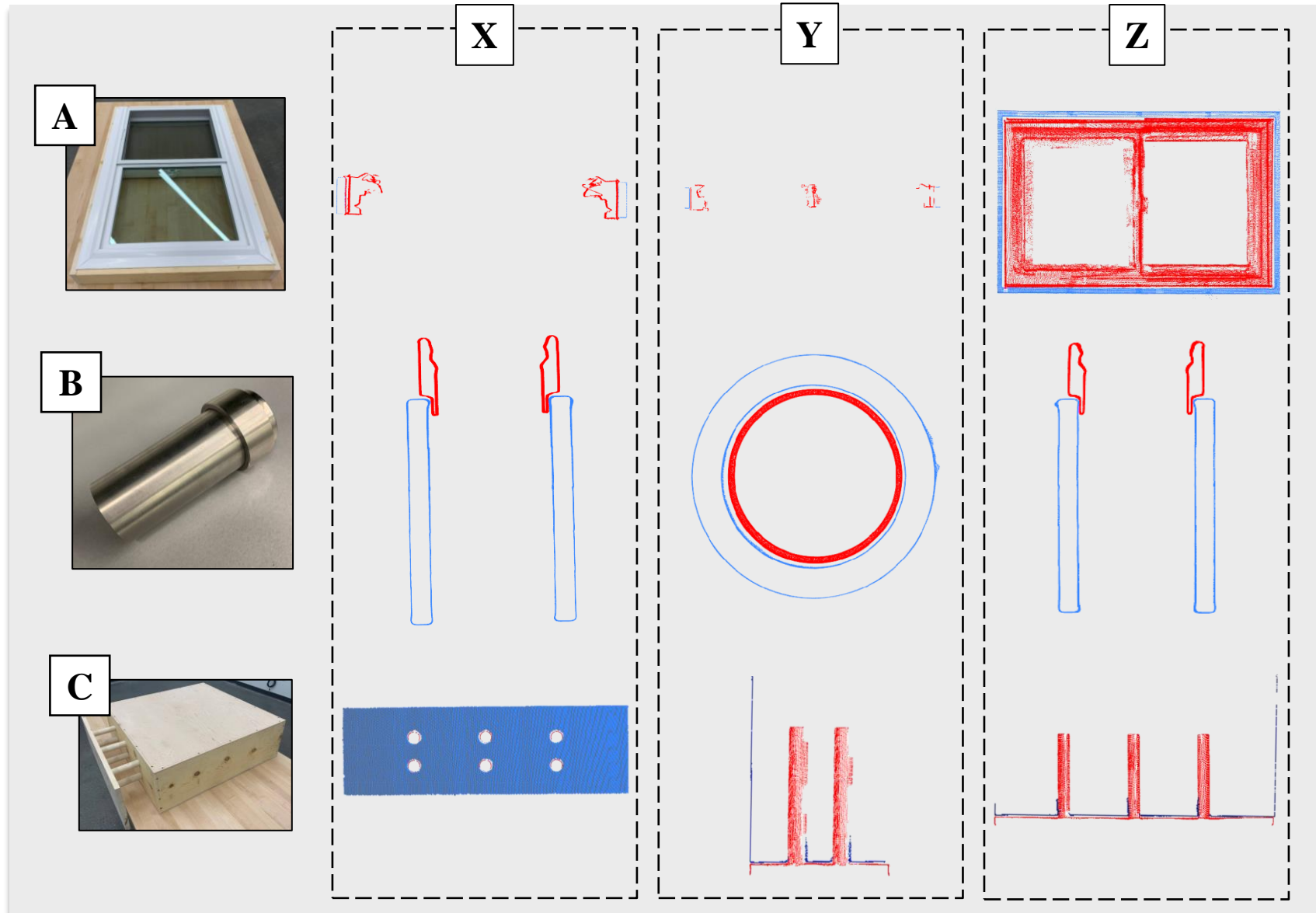
As-built to as-planned comparison



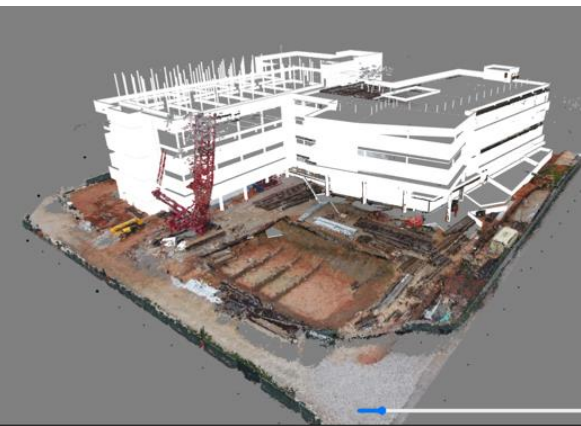
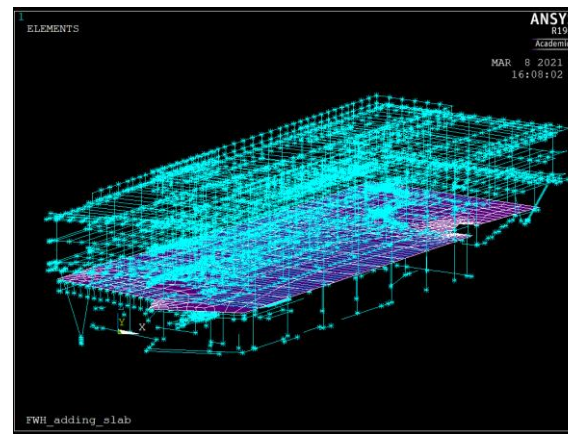
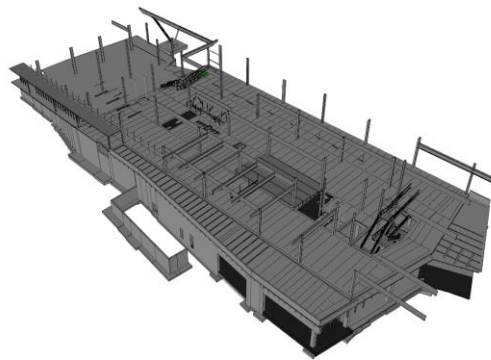
As-built to as-built comparison



Compatibility Check (also for Microreactor)



- Plant Sciences Building at NC State
 - CPMS
- Sample Prep Lab at INL
 - CPMS and compatibility check
- Structural specimen at Constructed Facilities Lab
 - Automated scanning using unmanned vehicles
- Fitts-Woolard Hall at NC State
 - BIM-to-ANSYS interoperability for building-piping interaction



- DOE ARPA-E
- DOE Versatile Test Reactor & Idaho National Laboratory
- CNEFS
- Facilities at NC State
- DPR Construction
- Skanska Construction



**U.S. DEPARTMENT OF
ENERGY**



Questions?

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